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RESEARCH IN FOCUS:

Effect of mindset on educational outcomes

INTRODUCTION

Dweck (2006; Dweck, Chiu, & Hong, 1995) outlines a theory of implicit beliefs that can explain differences in learning and performance that are to a large extent independent of intelligence or preparation. These implicit beliefs concern the extent to which people believe attributes such as intelligence can change. Those who believe that intelligence is a fixed trait that does not change over the course of their lives are entity theorists; they have a fixed mindset approach to learning, and tend to believe that when they fail, it is because they are stupid, or, for example, "bad at math," whereas when they succeed, they believe it is because they are smart. Those who believe that intelligence is malleable are incremental theorists; they are said to have a growth mindset, and they are more focused on the learning process: when they fail, incremental theorists tend to assume they had not studied enough, or needed to learn more, whereas when they succeed, they chalk it up to hard work rather than inborn ability. Entity theories take a performance approach to learning, whereas incremental theorists take a mastery approach.

Dweck (2006; 2007) emphasizes that mindset is learned and can be taught. Teachers who praise students for effort rather than performance encourage a growth mindset. This is particularly important because entity theorists tend to focus on performance rather than learning goals (Mangels, Butterfield, Lamb, Good, & Dweck, 2006). As such, a poor test result will be interpreted as a reflection of an entity theorist's self ("I'm dumb! I'm just not a good test-taker!") rather than on the effort they had put into learning. Importantly, this tends to be independent of intelligence or past ability.

> *"For example, a child with a fixed mindset who has excelled in math her entire life may react to her first challenging test (e.g., algebra) by becoming discouraged by a poor grade and deciding she doesn't like math. (Dweck, 2006). Conversely, a child with a growth mindset will think she needs to study harder to address the new, and welcome, challenge."*

However, both entity and incremental theorists are susceptible to distinct types of praise, and a skilled teacher can affect future behavior by emphasizing effort and gains in knowledge rather than smarts. Just taking a different approach to problems can help teachers and other adults influence their own mindset and associated outcomes.

As described above, mindset is part of individuals' theory of intelligence and learning, but it has been associated with behavior more broadly (e.g., Dweck, 2012; Yeager & Dweck, 2012). Generally, mindset refers to assumptions about basic human characteristics, such as talent (e.g., music and sports), personality, and different academic abilities (e.g., being "good at languages"; Mercer & Ryan, 2010). Dweck (2012) suggests that mindset can even serve to ameliorate political tensions between combative groups: in a series of studies, she investigated mindset and attitudes amongst Jewish Israelis and Palestinians, and found that exposure to information indicating that people could change (malleable mindset) decreased negative attitudes towards the opposing group and increased willingness to compromise. Dweck's take home message is that people can change; when it comes to attitudes, nurture is just as important—if not more so—than nature. In the same 2012 article, Dweck reports a study with Finnish school children in which growth mindset training, compared with coping training and a no-treatment control, resulted in less retaliatory behavior as assessed by the hot sauce paradigm (growth mindset group assigned 40% less hot sauce in retaliation) and teacher evaluations. Yeager and Dweck (2012) reported research that extends these findings to bullying and resilience in schools, and emphasized the role of educators in fomenting growth vs. fixed mindsets.

Recent research has shown that mindset interventions are particularly effective with at-risk student populations. In a study of 1,594 high school students from 13 schools (82% freshpersons), Paunesku and colleagues (2015) found that a growth mindset intervention administered in two 45 minute lab sessions resulted in improved GPA for at-risk students but not for those not at risk. Yeager and colleagues (2016) report similar results in a very large study (N = 3676) of students transitioning to high school. A revised growth mindset intervention was given online during two class periods at the beginning of the fall semester. Semester GPA was better for students in the experimental group than in the control group, but only for those who entered high school as low achievers (based on 8th grade GPA). The growth mindset intervention also meant reduced rates of poor performance for low, but not high, achievers. However, although high achievers in the experimental group did not see an improvement in grades, they did exhibit more hypothetical challenge-seeking behavior compared to the control, suggesting that growth mindset interventions can encourage challenge-seeking in high achievers whereas it improves academic performance in low-achievers.

EVIDENCE FOR THE MALLEABILITY OF MINDSET

In addition to those reported above, there are various experimental studies that have successfully manipulated mindset. Dweck (2000, 2006, 2007, 2012; Yeager & Dweck, 2012) describes many studies in which manipulating mindset improved student attitudes and performances. Other research groups report similar results. For example, in a series of studies, Mueller and Dweck (1998) tested the effect of different types of praise: children were given a series of Raven's progressive matrices test, and praised for intelligence or effort, or given no praise (control), and different feedback about how many they had completed correctly. Children praised for effort were more likely to profess learning rather than performance goals (it was the opposite for those praised for intelligence; control group was equally likely to select either type of goal), reported enjoying the tests more, were more likely to attribute their results to effort rather than intelligence, and were more likely to want to persist with the exercise after school.

Praise and feedback based on incremental rather than entity theory also affects learning and motivation in younger children (Cimpian, Arce, Markman, & Dweck, 2007). Cimpian and colleagues carried out a study with four-year-old children to investigate the effect of different types of praise for drawing. Children who had been given specific, effort oriented praise (e.g., "You did a good job drawing" rather than "you are a good drawer") were more likely to try again after mistakes, and more likely to want to draw again the next day. What's more, the children given praise in line with incremental theory showed more self-mastery, more positive affect, and less helplessness than those given performance-based (entity theory) praise.

Blackwell, Trzesniewski, and Dweck (2007) presented evidence that such effects lasted by following children from six grade

through the completion of middle school in a longitudinal study. Although theory of intelligence—as assessed by the Mindset scale at the beginning of the study—was not related to math scores in sixth grade, it did predict math achievement through junior high. Although the effect size was small overall, there was an interaction between mindset and time, such that for those with fixed mindsets did not improve their average math grades from the beginning of seventh grade through the end of middle school, whereas those with growth mindset improved significantly from seventh grade to the end of eighth grade. Importantly, theory of intelligence had a general effect on attitudes that influence learning in school such as effort, learning goals, and helplessness. When entered into a structural equation mediation model, these attitudes significantly mediated the relationship between mindset and math grades through middle school. In a follow-up study, Blackwell and colleagues successfully manipulated mindset: an incremental theory of intelligence intervention resulted in change in mindset accompanied by improvement in math grades in an at-risk sample of middle school students.

In another study, Mangels and colleagues (2006) investigated related brain activity. Specifically, they measured neural response (event-related potential: ERP) to feedback that was first performance-oriented (accuracy: right or wrong) and then learning-oriented (the actual answer): participants were assessed with the Mindset scale (Dweck 2000), took a general knowledge test while ERPs were measured; they received both types of feedback, and indicated how certain they were of their answers. Finally, they completed a surprise retest. Results suggested that entity and incremental theorists respond differently to feedback according to their expectations. Incremental theorists demonstrated significant brain responses to both expected and unexpected errors, whereas entity theorists only responded to negative feedback when it was unexpected. Importantly, incremental theorists were more likely to correct their previously incorrect answers on the surprise retest.

MINDSET IN THE CLASSROOM

In an educational setting, it is important to note that not only do implicit beliefs about intelligence affect teachers as well as students (Yeager & Dweck, 2012), but that both students and teachers can benefit from incremental theory training (Davis & Sumara, 2012). By merely praising effort (e.g., “Great job! You’ve really worked hard at mastering this lesson and it shows”) rather than ability (e.g., “Great job! You are so smart and it shows”), teachers can influence their students’ mindset and encourage learning rather than performance goals (Cimpian et al., 2007; Dweck, 2007). As noted above, mindset can be manipulated in experimental conditions (Blackwell et al., 2007; Dweck,, 2012), encouraged through praise for effort (Mueller & Dweck, 1998), and taught (Dweck, 2007). Importantly, mindset not only affects academic performance; it also influences social interactions: children with a growth mindset are more ready to accept that others can change, and act less aggressively (Dweck, 2012).

It is important to note that teacher attitudes affect teaching style; teachers who themselves have a fixed mindset are more likely to praise intelligence rather than ability, thus encouraging performance rather than learning goals (Yeager & Dweck, 2012). Teachers with fixed mindsets are also less likely to teach incremental theory and goals (Cutts, Cutts, Draper, O’Donnell, & Saffrey, 2010). However, because mindset is malleable and growth mindset can be taught and learned (e.g., Blackwell et al., 2007), such teachers can benefit from mindset training, learning skills that will carry over to the classroom.

MINDSET IN SERIOUS GAMES

There is evidence suggesting that mindset may be an important factor in the effectiveness of serious educational games, specifically designed to teach or supplement the teaching of a particular skillset (e.g., Lee, Heeter, Magerko, & Medler, 2012; O’Rourke, Haimovitz, Ballweber, Dweck, & Popovic, 2014). In a sample of over 15,000 elementary aged schoolchildren, O’Rourke and colleagues explored the effects of actively encouraging a growth mindset in a game designed to teach fractions. Children were randomly assigned to either the experimental condition, in which players received “brain points” for incremental mindset behaviors such as effort or generating new ideas, or to a control condition, in which players received “fraction points” for completing a problem correctly. Specific, growth mindset praise was given in the experimental condition (e.g., “You worked out your brain and kept trying!”). Although the effect sizes were small, children in the experimental condition played longer and completed more levels (the game was entirely voluntary), and demonstrated more growth mindset behaviors than the children in the control condition.

Because motivation is a vital factor in learning from serious games (Kickmeier-Rust, Mattheiss, Steiner, & Albert, 2012), and mindset affects motivation (Blackwell et al., 2007), theory of intelligence is likely to have an indirect effect on learning from games as well. Lee and colleagues (2012) found that undergraduates who had a growth mindset performed better in an educational game designed to teach US constitutional amendments. Compared with fixed mindset players, those with a growth mindset sought out more challenges, spent more time on feedback, and won more cases (the goal of the game).

ASSESSING MINDSET

Dweck et al. (1995; Dweck, 2000) designed a self-report scale that can be used to assess the degree to which people hold either a fixed or growth mindset. Initial scale development included three aspects of mindset: intelligence, morality, and world, and items focused fixed rather than growth mindset. Later versions of the Mindset scale have focused more generally on theory of intelligence, and are designed to assess growth vs. fixed mindset. The scale has been used extensively in research on people of all ages. It is an 8-item Likert-type scale with six choices ranging from strongly disagree to strongly agree (see Appendix). It is important to note that mindset is not a dichotomy across domains (Dweck, 2006), and there may be tests of mindset specific to a single area that can better assess it (e.g., Crum, Salovey, & Achor (2013) developed the Stress Mindset Measure, which measures the extent to which people believe stress is harmful vs. beneficial). Lee and colleagues (2012) supplemented the original Mindset scale with items specific to serious game play. However, the Dweck (2000) Mindset measure is the most tested in the domain of education and learning.

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